tion for contact effects and of the small difference between NH_3 and air mobilities. It points, however, in the same direction as the NH_3-air work; namely, to a preferential change in concentration of NH_3 molecules in the neighborhood of both ions. This effect is noticeable even at high concentrations of NH_3.

One thus sees in the negative ion the effect of the dielectric constant of NH_3 on the mobility without clustering while in the positive ion one has both effects superimposed, the clustering in this case increasing the mobility by its protective action, the dielectric constant causing a lowering as is to be expected. The results again indicate the importance of *minute* traces of gases in ion mobility work and thus indicate the necessity of extreme care in controlling the purity of the gases.

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NOTE ON THE CORRESPONDENCE PRINCIPLE IN THE NEW QUANTUM THEORY

BY CARL ECKART*

NORMAN BRIDGE LABORATORY OF PHYSICS, PASADENA

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1. *Synopsis.*—In this note it is shown that if the coördinate matrix of the new quantum theory is expanded in powers of Planck's constant, h:

$$X(mn) = X_0(mn) + hX_1(mn) + h^2\ldots\ldots \quad (1)$$

then $X_0(mn)$ approaches the coefficient of the $(m-n)$th harmonic in the Fourier expansion of the motion in the old theory when n approaches infinity. For large values of the quantum numbers, the Fourier coefficients thus constitute a first approximation to the matrix terms, which is in accordance with the experimental evidence embodied in Bohr's correspondence principle.

2. *The Expansion of the Characteristic Functions in Powers of h.*—The fundamental equation of the new quantum theory, for the case of one degree of freedom, is

$$-\frac{k^2}{2m}\frac{d^2\psi}{dx^2} + [U(x) - E]\psi = 0, \quad k = \frac{h}{2\pi} \tag{2}$$

where U is the potential energy function of the older theory and E is the energy of the system. The discrete values of E are determined by the condition that ψ be single valued and have no singularities for real values of x. This condition can only be satisfied for certain values of E.[1]

If we set $\psi = e^{\phi/k}$ (2) becomes

$$-\frac{1}{2m}\left(\frac{d\phi}{dx}\right)^2 + U - E - \frac{k}{2m}\frac{d^2\phi}{dx^2} = 0.$$

Expanding ϕ in powers of k: $\phi = \phi_0 + k\phi_1 + \ldots$, we obtain the following equations to determine the successive members of the series:

$$-\frac{1}{2m}\left(\frac{d\phi_0}{dx}\right)^2 + U - E = 0$$

$$2\frac{d\phi_0}{dx}\frac{d\phi_1}{dx} + \frac{d^2\phi_0}{dx^2} = 0.$$

The first of these can readily be seen to have as its solution $\phi_0 = iS(xJ)$ where S is the Hamilton-Jacobi function and J the action variable of the older theory.[2] In every case thus far studied, the condition on ψ is satisfied only when[3]

$$J = \left(n + \frac{1}{2}\right)h = J_n \qquad n = 0, 1, 2 \ldots.$$

Hence the sequence of characteristic functions is

$$\psi(x,n) = e^{\frac{2\pi i}{h}\left[S(xJ_n) + \frac{h}{2\pi}\cdots\cdots\right]} \tag{3}$$

where $\frac{h}{2\pi}\ldots.$ represents the aggregate of terms of order of magnitude h or smaller.

3. *The Relation of the Matrix Terms to the Fourier Coefficients of the Older Theory.*—The matrix corresponding to the coördinate x may be defined by the equation[1]

$$x\psi(nx) = \sum_{m=0}^{\infty} X(mn)\psi(mx).$$

Substituting the expression (3)

$$x = \sum_{m=0}^{\infty} X(nm)\, e^{\frac{2\pi i}{h}\left[S(xJ_m) - S(xJ_n) + \frac{h}{2\pi}\cdots\cdots\right]}. \qquad (4)$$

If the exponent of each term in (4) be expanded in powers of $J_m - J_n = (m - n)h$, and if $X(mn)$ is also expanded in powers of h, the result is

$$x = \sum_{m=0}^{\infty} X_0(mn)\, e^{2\pi i(m - n)\frac{\partial S}{\partial J}} + R(h). \qquad (5)$$

where

$$\lim_{h = 0} R(h) = 0.$$

On the other hand, in the older theory, the expression of x as a function of time is obtained as

$$x = \sum_{p=-\infty}^{+\infty} A(p)\, e^{2\pi i p\omega t}$$

where $\omega = \frac{\partial E}{\partial J}$. This equation is identical with the equation[3]

$$t = \frac{\partial S}{\partial E}.$$

Hence the equation

$$x = \sum_{-\infty}^{+\infty} A(p)\, e^{2\pi i p \frac{\partial E}{\partial J}\frac{\partial S}{\partial E}}$$

is an identity in x. If $p = (m - n)$, it may be written

$$x = \sum_{m=0}^{\infty} A(m - n)\, e^{2\pi i(m - n)\frac{\partial S}{\partial J}} + T(n) \qquad (6)$$

where

$$\lim_{n = \infty} T(n) = 0.$$

Comparing (5) and (6), we see that

$$\lim_{h = 0,\, n = \infty} X(mn) = A(m - n)$$

and we obtain the theorem:

As h approaches zero and n approaches infinity in such a way that $\left(n + \frac{1}{2}\right) h = J$, the matrix term $X(mn)$ approaches the coefficient of the $(m - n)$th harmonic in the Fourier expansion of the classical motion.

* NATIONAL RESEARCH FELLOW IN PHYSICS.

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[3] Cf. Wentzel, *Zs. Physik*, **38**, 518 (1926).

MINIATURE-α—A SECOND FREQUENTLY MUTATING CHARACTER IN DROSOPHILA VIRILIS

BY M. DEMEREC

DEPARTMENT OF GENETICS, CARNEGIE INSTITUTION OF WASHINGTON, COLD SPRING HARBOR, N. Y.

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The first frequently mutating character observed in *Drosophila virilis* was the body character "reddish,"[1] which was found to mutate frequently to wild type. The time of occurrence of the mutations was found to be limited to the maturation divisions of heterozygous females; no mutation in somatic cells was ever detected. Also no mutations were observed in male or homozygous reddish females. The frequency with which reddish mutates to wild type varies greatly in the different individuals obtained from the same parents, which makes it possible to select for low or high frequency of mutations. In that way, from a mutating reddish, a constant reddish can be isolated very easily, or if the selection is carried in the other direction, a high frequency mutating line can be established.

Miniature-α wing character is the second frequently mutating character found in *Drosophila virilis*. The behavior of miniature-α differs in several respects from the behavior of reddish, but like reddish, miniature-α mutates to wild type.

Origin of Miniature-α.—A single miniature male was found among 177 flies of an experiment with reddish, and from this male all miniature-α flies were derived. In the F_2 generation from a mating between that male and several wild-type females, in addition to 258 wild-type females and 282 wild-type males, 11 miniature males were obtained. Those results showed that the character is inherited and indicated that it is sex linked.

Tests for Mutability.—In the first and the following F_2 generations and backcrosses with miniature-α very few miniature flies were obtained. One of the several explanations to account for this deficiency was the possibility that miniature-α reverts frequently to wild type. To test that possibility miniature was crossed with stocks carrying several sex-linked characters, since F_2 and backcross data showed that miniature-α is located in the sex chromosome. Miniature-α was also crossed with